# Chapter 1

# Introduction

## 1.1 Introduction

Aphasia is an acquired impairment of language in adults, resulting from focal brain damage. This definition excludes several other possible types of language impairment, such as children's specific language impairment (SLI) and deficits related to dementia and other neurogenic diseases. Many speakers with aphasia produce literal paraphasias in speech, i.e. errors that are form-related to their intended targets. However, this does not mean that such aphasics all suffer from the same underlying deficit. Literal paraphasias may be generated at various stages during the process of speech production.

In this dissertation, I map specific clusters of aphasic symptoms onto a model for unimpaired speech production. Relating the literal paraphasias produced in different types of aphasia to levels of processing makes it possible to investigate the type and amount of phonological structure that is present at these various processing levels. For this, I will look at effects of phonological markedness in the paraphasias of different types of aphasics. It is argued that phonological markedness is domain-specific and that, therefore, the presence or absence of markedness effects sheds light on the presence or functionality of these phonological domains at the level of deficit of different aphasic speakers.

In particular, the focus is on syllable structure. It is well documented that children acquiring language reduce clusters of consonants in syllables to single consonants and that this cluster reduction is not entirely random. The type of syllables children end up with are argued to reflect an unmarked, or preferred syllable structure. Within phonological theory, there is debate about whether the relative markedness of structures such as syllables is the result of physical/functional constraints, for example on articulatory possibilities or perceptual efficiency, or whether they are reflections of random preferences that are universally innate to all human beings.

The type of cluster reduction observed in children has also been reported in studies on the production of literal paraphasias in aphasia, though not for all types

of aphasia. This means that syllable structure markedness, and thus the presence of syllable structure, can be related to specific levels of processing. Indirectly, such an approach may shed light on the question of whether syllables are articulatorily functional. Together with discussions about the background assumptions that are necessary in order to adopt this approach, a study into the manipulation of monosyllables by phonologically and phonetically impaired aphasic speakers forms a major part of this dissertation.

I also present discussions about the relation between formal linguistic theory and language impairment data, speech processing models based on experimental data, and studies into brain activation and language processing. I will defend the position that formal linguistic theory, even if it is mainly aimed at the description of language competence, should be compatible with results from related fields. The word 'compatible' is important: linguistic theory is not necessarily about speech production in performance, so it does not have to reflect the workings of the brain *directly*, but where assumptions are made about the generation of output forms, e.g. about distinctions and temporal relations between processing stages, these should not be contradictory to evidence from fields that are more directly aimed at language processing in performance.

Phonological Optimality Theory is an example of such a formal linguistic theory. In its standard application, there is only one level of evaluation in this theory, which is deemed an asset in terms of representational economy. I will argue that this is in direct conflict with what is known about phonological processing and that the psychological reality of a theory such as Optimality Theory is enhanced with the incorporation of multiple levels of evaluation, read processing.

Although the chapters of this dissertation together form a developing argument, they can also be read in isolation. I have endeavoured to be as little repetitive as possible, but some discussions will inevitably return in various guises. What follows is a brief overview of the different chapters.

## 1.2 Overview

Chapter 2 provides the phonological background to the studies presented in later chapters. It introduces the motivation for the recognition of syllables as units in the prosodic hierarchy and discusses their shape and structure. Furthermore, it introduces the notion of markedness, its functional or innate basis and its relation

to child language acquisition. The chapter ends with an introduction to phonological Optimality Theory, in which linguistic rules are abandoned in favour of output goals of well-formedness. These output constraints may sometimes serve conflicting 'purposes' and the Optimality-theoretic representation of these conflicts is especially suitable for the representation of variation in speech output.

Chapter 3 discusses how aphasia may be used as a window on the process of phonological encoding. It introduces a model of unimpaired speech production and, against the background of this model, discusses the relation between impaired and unimpaired speech. The notion of 'transparency' is important here: aphasia does not entail the formation of new grammars that are essentially unrelated to unimpaired grammars. Instead, it entails damage to the otherwise normally functioning language system. Three classic syndromes that yield literal paraphasias in speech production are Wernicke's aphasia, Broca's aphasia and conduction aphasia. Particular attention is paid to conduction aphasia, of which two types are distinguished: repetition conduction aphasia and reproduction conduction aphasia. The first is regarded as a deficit in the short-term retention of elements in a phonological store, while the latter is a deficit in phonological encoding. The relation between the phonological encoding deficit and phonological working memory functions is subject to debate. Where conduction aphasia is dealt with in further chapters, the reproduction type is implied.

Chapter 3 also offers a detailed dissection of the process of phonological encoding, into four aspects, and relates these to what studies into the syndrome of (reproduction) aphasia might contribute to our knowledge with respect to the phonological planning process. The input to phonological encoding consists of lexically stored information about metrical frames and (segmental) sound elements. The time course of the process is characterised in different models as either serial or parallel, relating to whether segments in a planning frame are activated either one-by-one or simultaneously. With respect to the output of the phonological encoding process, the question is to what extent this is specified for phonetic detail. The approach adopted here is that there is a difference between a still fairly abstract phonological speech plan, which is the output of phonological encoding, and the speech plan in terms of articulatory gestures, which is the output of articulatory phonetic encoding. The domain of phonological encoding refers to the size of the chunks that are encoded. It has been suggested that this domain is the phonological phrase, and I point out that this has consequences for the nature of the hypothesised incrementality of the speech production model that is adopted.

Phonological evidence indicates that the formation of phonological phrases involves feedback from phonological representations to syntactic representations, which is potentially problematic for speech production models that do not allow such feedback.

Chapter 4 introduces the distinction between fluent aphasic speakers and nonfluent aphasic speakers who produce literal paraphasias. The fluent aphasics in this study are assumed to suffer from a deficit in the formation of a correct phonological plan, whereas the nonfluent patients have a deficit in the execution of this plan, in terms of articulatory phonetic planning. Of each group, 10 patients were tested with a monosyllabic repetition task. Their literal paraphasias are analysed in terms of syllable structure manipulation. The results indicate that the literal paraphasias of phonologically impaired patients show effects of syllable markedness conflicting with segmental markedness, whereas phonetically impaired patients only show effects of segmental markedness.

The presence of syllable structure is thus related to a phonological level of processing, while segmental structure is related to both phonological and phonetic levels of processing. This analysis if further formalised in chapter 5, which offers an Optimality-theoretic account of the data presented in chapter 4. This chapter also introduces a variant of Optimality Theory that has been applied to the description of output variance in child language acquisition, but which is also very useful in the representation of aphasia in the formal theory.

Chapter 6 presents nine case studies of aphasic patients who produce literal paraphasias. Their respective syndromes are compared with an analysis in terms of deficits at three specific levels of processing: lexical access, phonological encoding and phonetic encoding. In order to pinpoint the affected levels of deficit in these patients, I use three tasks with the same items: naming, repetition and phoneme detection. Each task makes different demands on the three distinguished relevant levels of processing. On the basis of the results on these tasks, then, the functional level of deficit in these patients is determined.

Chapter 7 links up the main results and conclusions of the individual chapters.